

Work Task E6: Cottonwood Genetics Study

FY05 Estimate	FY05 Actual	Cumulative Accomplishment Through FY05	FY06 Approved Estimate	FY07 Proposed Estimate	FY08 Proposed Estimate	FY09 Proposed Estimate
\$50,000	\$109,927	\$219,931	\$25,000	\$15,000	\$15,000	\$15,000

Contact: Gregg Garnett, (702) 293-8644

Start Date: FY04 **Expected Duration:** FY09 decision point

Long-Term Goal: Restoration Research

Conservation Measures: WIFL1, WRBA2, WYBA3, CRCR2, YHCR2, YBCU1, ELOW1, GIFL1, GIWO1, VEFL1, BEVI1, YWAR1, and SUTA1

Location: Reach 4, Cibola National Wildlife Refuge, 1/2 mile east of River Mile 97, AZ

Purpose: This research project is designed to determine the relative levels of genetic diversity in the remaining stands of Fremont cottonwood (*Populus fremontii*) across the Southwest; and investigate the influence of this genetic diversity and local genetic adaptations on community diversity in the context of habitat restoration. The expression of these genetic adaptations may manifest themselves in trees possessing superior traits with respect to growth, reproduction, survival, and the habitat quality they influence. Previous research indicates that diversity in cottonwoods can have a direct effect on associated trophic communities and can lead to increases in wildlife diversity. A benefit of genetically diverse stands of trees in dominant riparian communities is increased plasticity to varying environmental perturbation including, disease, insect outbreaks, and climate change. Reclamation will use the information gained from this study to increase knowledge and success in creating functional wildlife habitat, and to insure that adequate genetic diversity of dominant riparian plants is included in habitat creation projects.

Connections with Other Work Tasks (past and future): This Work Task was previously included in the FY04 Work Task as Farm Unit #1 (Cottonwood Genetics), Cibola National Wildlife Refuge (D3) and in Draft FY05 Work Tasks as a portion of Farm Unit #1 (Genetics, Mass Planting, Seed), Cibola National Wildlife Refuge (E6). All Work Tasks in Section E that target cottonwood-willow habitat.

Project Description: Reclamation has entered into a five-year land use agreement with the FWS to conduct restoration research in Farm Unit #1 at Cibola NWR. The agreement expires in FY09 at which point a decision will be made to continue research activities, manage land cover types as habitat created during the research for the 50-year life of the LCR MSCP program, or discontinue funding. Information is lacking regarding the relative levels of genetic diversity within the remaining cottonwoods along the LCR and the impact of this genetic diversity as it pertains to community structures and ultimately, wildlife diversity within restoration sites. In an effort to increase knowledge and success in creating functional wildlife habitat, Reclamation solicited the scientific community for proposals to investigate these relationships. NAU was

awarded a cooperative agreement and contributed matching funds from a National Science Foundation grant to undertake these investigations. The project includes genetically screening remaining stocks of Fremont cottonwood trees in stands throughout the Southwest and selecting genetically distinct trees, representative of these locations, to be planted in an experimental garden with a replicated design. The experimental garden will be monitored to observe how these genetic differences may be expressed in terms of growth, reproduction, and survival in a typical restoration site; as well as, genetic traits that influence superior habitat quality (including those that may support LCR MSCP covered species). These genetic traits will likely be important for long-term survival and for maintaining habitat quality and health throughout the life of the program. Sampling will be conducted to indicate species diversity and richness at multiple trophic levels with respect to soil microbes, invertebrates, and vertebrate communities associated with specific cottonwood genotypes. The experimental garden will be located at Cibola NWR on agricultural land with water and irrigation infrastructure.

Previous Activities: The cooperative agreement was awarded in September 2004 (FY04) to initiate work in the amount of \$110,004 were obligated.

FY05 Accomplishments: NAU researchers collected leaf tissue from 600 Fremont cottonwood trees distributed in five states. The researchers isolated DNA from approximately 250 trees and performed genetic screening and analysis of leaf tissue DNA. Preliminary results indicate that genetic diversity is high in Fremont cottonwood within particular locations and across the Southwest. At this time, it is unknown how these genotypes will express these differences when planted in the experimental garden.

Sixteen (16) genotypes were selected from various locations across the Southwest to be included in the experimental garden, and cuttings from these trees were propagated at NAU greenhouse facility (see figure E6a). A map was developed for the experimental garden's replicated planting design and addresses the interaction of spatial, genetic, and geographic effects on cottonwood communities and ecosystems. Over 10,000 trees were propagated to fulfill the planting design and compensate for potential mortality. Preliminary observations suggest that cottonwood genotypes differ in propagation success and dormancy behavior. Additional observations corroborate information regarding non-dormant collection and propagation success.

In July 2005, a modification was made to the cooperative agreement with NAU. The site selected at Cibola NWR included two fields with more acreage than anticipated in the original planting design (see figure E6b). In order to completely fill the site, the experimental garden had to be expanded. This change was considered beneficial because it would allow for a more robust study design and would maintain consistent coverage over the entire fields. To support this increase in project scope, additional funding was obligated to cover the costs for the additional trees (collection, propagation, and greenhouse space), and to cover the increased staffing to support the expansion of the experimental garden (increased planting and monitoring costs). This modification translated into an underestimate for the FY05 budget projection by roughly \$60,000. Planting of the experimental garden (originally targeted for spring 2005) was delayed until fall 2005 (FY06) to ensure the propagated trees had adequate root development.

Proposed FY06 Activities: Planting of the experimental garden occurred in October/November 2005. Reclamation provided personnel to assist NAU in planting and a tractor and operator as part of contracted farming services. Cibola NWR supplied the tree planting equipment. Survivorship surveys will be conducted by NAU in FY06 as well as baseline arthropod monitoring and establishment of a reference collection of invertebrate species from adjacent cottonwood stands. Additional support from Reclamation is expected to be limited and may include staff time for agreement coordination and administration, equipment purchase or rental, and minor field support.

FY07 Proposed Activities: NAU is scheduled to perform any needed mortality replacements for the trees in the experimental garden in late winter/early spring of 2007. Data collection including trophic responses and measurement of physical parameters will continue through 2007. These data will include samples of soil microbes, invertebrate communities, and monitoring growth and development of trees. This information is necessary to determine if genotype differences important for restoration are being expressed. The majority of this portion of the study will be funded through NAU cost share. Support from Reclamation will be limited and may include staff time for agreement coordination and administration, equipment purchase or rental, and minor field support.

Pertinent Reports: A study plan is available upon request.



Figure E6a: Propagated Fremont cottonwoods at NAU greenhouse facility.



Figure E6b: Aerial view of fields selected and prepared for planting at Cibola NWR.